505-10-01-6

Earth Science Data Information System (ESDIS) Project Level 2 Requirements Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) Requirements

Volume 6

Revision A

December 1996

National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

Earth Science Data Information System (ESDIS) Project Level 2 Requirements Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) Requirement

Volume 6

December 1996

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Preface

This document provides the requirements for the EOSDIS Backbone Network (EBnet) system.

This document replaces the EOS Communications (Ecom) portion of the EOS Data and Operations System (EDOS)/Ecom Level 2 Requirements Specification Volume 2 (Goddard Space Flight Center [GSFC] 423-35-01) and incorporates EOS Data and Information System (EOSDIS) Science Network (ESN) requirements from the Earth Science Data and Information System (ESDIS) Project Level 2 Requirements Volume 1 EOSDIS Core System (ECS) (423-10-01-1) and from the Communications Requirements for the ECS project document (220-CD-001-003).

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Abstract

This document provides a brief description of EBnet and presents its level 2 requirements. It includes the programmatic requirements, overall system requirements, functional requirements, and interface requirements.

This Volume is a companion document to the ESDIS Project Level 2 Requirements Volume 0: Overall ESDIS Project Requirements.

Volume 0 should be used to understand the Mission to Planet Earth (MTPE), the context of EBnet, and the requirements hierarchy.

Keywords: *EBnet, EOSDIS Backbone Network, ESDIS, Earth Science Data and Information System, EOSDIS, EOS Data and Information System, EOS, Earth Observing System, MTPE, Mission To Planet Earth.*

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Section 1. Introduction

1.1 Scope

The EBnet provides wide-area communications circuits and facilities between and among various EOS Ground System (EGS) elements to support mission operations and to transport mission data between EOSDIS elements. The relationship of EBnet to other elements supporting EOS is shown in Figure 1-1. EBnet is responsible for transporting spacecraft command, control, and science data nationwide on a continuous basis, 24 hours a day, 7 days a week. Real-time data includes mission-critical data related to the health and safety of on-orbit space systems and raw science telemetry as well as prelaunch testing and launch support. Science data includes information collected from spacecraft instruments and various levels of processed science data including expedited data sets, production data sets, and rate-buffered science data.

In addition to providing the wide-area communications through common carrier circuits for internal EOSDIS communications, EBnet serves as the interface to other systems such as Distributed Active Archive Centers (DAACs), users, and the National Aeronautics Space Administration (NASA) Science Internet (NSI). EBnet also includes a campus interface, which provide communications between the Wide Area Network (WAN) and Local Area Network (LAN). CH02

Key functional objectives of EBnet are:

- Transport - EBnet must provide means to transport spacecraft forward and return data between the EOSDIS Core System (ECS) and EDOS and to transport science data between DAACs.
- Network Management - EBnet must enable and assure on a system-wide basis the management of system resources and system operations.

Efforts have been initiated to integrate the support efforts of NASA Communications (Nascom) Wide Area Network (WAN), Program Support Communications Network (PSCN) WAN, Aeronautics Network (AEROnet) and NASA Internet (NI) under the NASA Integrated Services Network (NISN) organization. Ultimate responsibility for EBnet operations, maintenance and sustaining engineering support will reside with NISN. CH02

1.2 Information Format

Section 1 contains introductory information; Section 2 lists applicable documents. The document numbers are indicated within brackets, [ ], the first time the documents are referenced (after Section 2). The requirements are presented in Section 3. Supplemental information in Section 3 is enclosed within braces, { }, to distinguish the requirements from informational text. This supplemental information is included to help the readers fully understand the environment in which the requirements apply. Individual requirements are identified by a specific EBnet Requirements Identification Number (26XXX). CH02

The first occurrence (subsequent to Sections 1 and 2) of each glossary entry is underlined.

The verb "will" is used in each EBnet capability statement. Where necessary, to avoid confusion, the phrase, "will provide the capability," is used.

The verb "shall" is used in each user requirement statement. Where necessary, to avoid confusion, the phrase, "shall provide the capability," is used.

1.3 Open Issues

Issues List

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Issue #	Issue Description	Work-Off Plan	Projected Resolution Date
1	An RMA is needed for maximum failure time such that the Level 1 requirement to provide data from the satellite to the next highest level of processing within 48 hours can be met or changed.	ESDIS Requirements Engineering Group working on solution and will submit CCR	1/96
2	The security requirements to protect all data as Sensitivity Level 3 (EB2340) and the requirement for C2 controlled access protection (EB2330) should be reviewed by the ITSO for Code 505. The sensitivity levels for ECS, including FOS, and EDOS were approved as level 2.	ITSO will be submitting CCR to upgrdade EDOS and ECS to Sensitivity Level 3	TBD
3	Network management responsibility for ESDIS on an end-to-end basis has not been resolved. This could lead to finger pointing and a lack of understanding of who carries/monitors a problem until it is fixed across all systems end-to-end.	Dist. Systems and Network Manager is developing a network operations concept document.	TBD
4	EBnet loading engineering analysis needed for Landsat 7 interface equipment.	Dist. Systems and Network Manager is performing a loading study.	TBD

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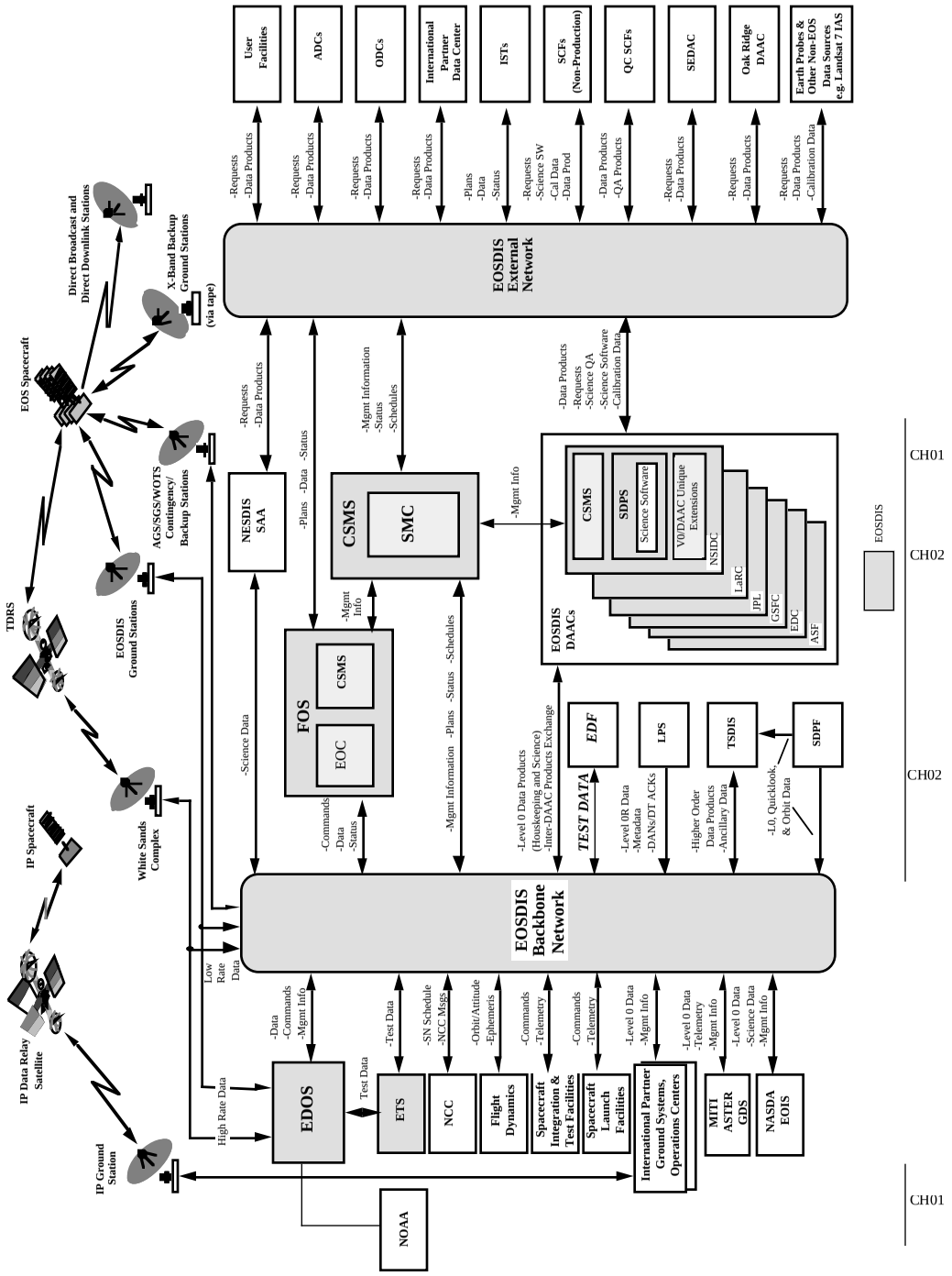

Figure 1-1. EOS Ground System

Figure 1-2. EOSDIS Backbone Network
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Section 2. Applicable Documents

2.1 Source Document

[1] Execution Phase Project Plan for Earth Observing System (EOS), Revision A, NASA170-01-01, May 1995

[2] Earth Science Data Information System (ESDIS) Project Level 2 Requirements Volume0, Overall ESDIS Project Requirements, GSFC 423-10-01-0, February 18, 1993

2.2 Reference Documents

[3] Quality Program Provisions for Aeronautical and Space System Contractors, NASA Handbook (NHB) 5300.4 (1B), April 1969

[4] Deleted CH02

[5] Reliability Program Provisions for Aeronautical and Space System Contractors, NHB 5300.4 (1A-1), January 1987

[6] *Department of Defense Trusted Computer System Evaluation Criteria,* Department of Defense (DOD) 5200.28-STD, December 1985

[7] *NASA Automated Information Security Handbook,* NASA Handbook (NHB) 2410.9, NASA, September 1990

[8] *NASA Communications (Nascom) Access Protection Policy and Guidelines,* 541-107, Revision 3, GSFC, November 1995 CH02

[9] *NASA Communications System Acquisition and Management,* NASA Management Instruction (NMI) 2520.1D, NASA, November 18, 1991

[10] EBnet Traffic Database, Nascom, January 1997, including changes through EBnet Traffic CCR #15 CH02

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Section 3. EBnet Level 2 Requirements

3.1 EBnet Requirements

{This section contains the following requirements: (1) programmatic, (2) EBnet overall system, (3) EBnet functions; and (4) interfaces.}

3.1.1 Programmatic

3.1.1.1	EBnet shall provide appropriate training and training aids to operators and technicians for each EBnet component.	261000
3.1.1.2	EBnet shall prototype all functions and standards that are user-sensitive, high risk, or involve untried approaches and technologies.	261010
3.1.1.3	In support of system safety requirements, EBnet shall ensure all safety considerations are satisfied in conjunction with EDOS and ECS.	261020

3.1.2 Overall System

{This section defines requirements which are applicable to the EBnet as a system.}

3.1.2.1 Generic System Requirements CH02

3.1.2.1.1	EBnet shall be modular in design.	262000
3.1.2.1.2	EBnet internal design changes shall be as transparent to the user to the maximum extent possible. Any changes that will not be transparent must be coordinated with the user community before implementation.	262010
3.1.2.1.3	EBnet shall maximize opportunities for commonality within the system.	262020
3.1.2.1.4	EBnet shall include development, testing, operations, and maintenance for the life of the supported missions in Table 8-1 of the Execution Phase Project Plan for EOS [1], including Advanced Earth Observing Satellite (ADEOS) II, Tropical Rainfall Measuring Mission (TRMM), LANDSAT-7/ETM, EOS-AM, EOS-PM, LASER Altimetry (ALT), Chemistry (CHEM), Activity Cavity Radiometer Irradiance Monitor (ACRIM), RADAR ALT, Stratospheric Aerosol and Gas Experiment (SAGE) III, and Solar Stellar Irradiance Comparison Experiment (SOLSTICE).	262030
3.1.2.1.5	For any custom developed applications, EBnet shall conform to the quality assurance requirements in accordance with NASA Handbook 5300.4 (1B), Quality Program Provisions for Aeronautical and Space System Contractors, [3] tailored to the EBnet project and mission requirements. There shall be no unique quality requirements levied for Commercial Off-The-Shelf (COTS) hardware and software over and above those used by the vendor. COTS hardware quality assessments shall be performed through product sampling prior to procurement.	262040
3.1.2.1.6	EBnet shall provide a sustaining engineering capability.	262050

3.1.2.1.7 EBnet shall support operations 24 hours per day, 7 days per week on a continuous basis. 262060

3.1.2.1.8 EBnet shall be designed to accommodate growth in data rates and volumes for communications and networks in accordance with traffic requirements identified in Table 4 of the ESDIS Project Level 2 Requirements Volume 0, Overall ESDIS Project. 262070 CH02

3.1.2.1.9 EBnet shall be able to add and remove common carrier interfaces and system elements without disruption of network service. 262080

3.1.2.1.10 EBnet distributed elements shall operate as a single integrated and cohesive information system. 262090

3.1.2.1.11 EBnet transport services shall be transparent to users. Users shall not require any special knowledge of the location and function of the EBnet distributed element or the transport services being used. 262100

3.1.2.1.12 EBnet shall provide a level of service where less than 0.05 percent of all Internet Protocol (IP) packets are dropped due to errors for both real time and science IP data. 262110 CH02

3.1.2.1.13 EBnet shall transport data within the maximum one-way delay of 0.5 seconds. 262120

3.1.2.1.14 EBnet shall include development, testing, operations, and maintenance from the completion of the life of EOS and LANDSAT plus 3 years. 262130

3.1.2.1.15 EBnet shall support all of the EOS spacecraft mission phases and mission modes. 262210

3.1.2.1.16 EBnet shall provide a level of service where the Bit Error Rate (BER) for clock and data services should be 1x10-5 or better. 262135 CH02

3.1.2.2 Integration and Test

3.1.2.2.1 EBnet shall support independent test activities of the end-to-end EOSDIS throughout its life. 262140

3.1.2.2.2 EBnet shall provide system verification and evaluation test definitions for transmission quality testing of its common carrier networks used. 262150

3.1.2.2.3 The communications and networks utilized or provided by the EBnet shall be capable of being tested and perform simulations during all phases of EOSDIS development and mission operations without interfering with the normal communications and networking traffic. 262160

3.1.2.2.4 (Deleted) CH02

3.1.2.2.5 EBnet shall support the revalidation of performance capabilities whenever an element(s) upgrade/enhancement is made to EBnet which may cause a change in performance. 262180

3.1.2.2.6 EBnet shall provide tools and metrics to support testing, system performance monitoring, fault isolation, verification and validation of the end-to-end ground system. 262190

3.1.2.3 Deleted CH02

3.1.2.4 Reliability, Maintainability, and Availability

3.1.2.4.1 EBnet shall follow the intent of the applicable reliability program tasks delineated in NHB5300.4 (1A-1), Reliability Provisions for Aeronautical and Space System Contractors, [5] tailored to the EBnet project and mission requirements. Reliability prediction data shall be obtained from the vendors. 262220

3.1.2.4.2 (Deleted) CH02

3.1.2.4.3 The EBnet maximum downtime shall be consistent with best commercial practice and experience. (Ref: EBnet Outage Data) 262231

3.1.2.4.4 EBnet shall have an operational availability of 0.9998 as a minimum for forward and return real-time data communication exclusive of support to EOSDIS Ground Stations at Alaska and Norway. 262240

3.1.2.4.5 EBnet shall have a Mean Time To Restore Service (MTTRS) of 1 minute or less for forward and return real-time data communication exclusive of support to EOSDIS Ground Stations at Alaska and Norway. 262250

3.1.2.4.6 EBnet shall have an operational availability of 0.98 as a minimum for forward and return real-time data communication in support of EOSDIS Ground Stations at Alaska and Norway. 262251

3.1.2.4.7 EBnet shall have a Mean Time To Restore Service (MTTRS) of 4 hours or less for forward and return real-time data communication in support of EOSDIS Ground Stations at Alaska and Norway. 262252

3.1.2.4.8 EBnet shall have an operational availability of 0.98 as a minimum for science data transfer communication. 262260

3.1.2.4.9 EBnet shall have an MTTRS of 4 hours or less for science data transfer communication. 262270

3.1.2.4.10 EBnet support for the interface between the Landsat Processing System (LPS) and the EOSDIS Core System (ECS) shall have an operational availability of 0.999 at a minimum and an MDT of two (2) hours or less. 262275

3.1.2.4.11 EBnet shall provide a backup to the interface between the Landsat Processing System (LPS) and the EOSDIS Core System (ECS) with a switchover time of 15 minutes or less from the primary interface to a backup capability. 262276

3.1.2.4.12 EBnet shall have an operational availability of 0.96 as a minimum for network management. 262280

3.1.2.4.13 EBnet shall have an MTTRS of 4 hours or less for network management. 262290

3.1.2.5 System Access

3.1.2.5.1 EBnet shall provide EBnet operators with access to local information management services at the nodes. 262300

3.1.2.5.2 EBnet operator interface shall be tailored to functions which are authorized for the operator. 262310

3.1.2.6 Security

3.1.2.6.1 EBnet shall provide access monitoring to compile and report security violations and attempted security violations. 262320

3.1.2.6.2 EBnet network management systems shall meet the criteria of Level of Security Sensitivity (C2) controlled access protection defined in Department of Defense (DOD) Trusted Computer System Evaluation Criteria as applicable. [6] 262330

3.1.2.6.3 EBnet shall protect all data as Sensitivity Level 3 as specified in the NASA Automated Information Security Handbook except for Section 403d(2), Information and Application Labels. [7] 262340

3.1.2.6.4 EBnet shall support users that comply with NASA Communications Access Protection Policy and Guidelines. [8] 262350

3.1.2.7 End-To-End Fault Management

{EBnet end-to-end fault management requirements address the ability of the EBnet to support fault identification, isolation, and correction for the network.}

3.1.2.7.1 The EBnet shall support end-to-end system fault isolation, including the capability to identify a failing node, element, and/or service, to the level necessary to correct the fault. 262360

3.1.2.7.2 The EBnet shall maintain knowledge of current operational status of all EBnet elements. 262370

3.1.3 EBnet Functions

3.1.3.1 Mission Operations

3.1.3.1.1 EBnet shall transport operational data in accordance with NMI 2520.1D. [9] 263000

3.1.3.1.2 EBnet/Nascom shall provide voice communications in support of mission operations, including all prelaunch activities. 263010

3.1.3.1.3 EBnet shall provide the capability to transport EOS operational data among EDOS facilities, ECS operational facilities, and the operational EOS users of EDOS data products including the EOS International Partners in a data-driven mode. 263020

3.1.3.1.4. EBnet/Nascom shall provide the capability to support contingency-mode operations with the ground stations at Alaska (AGS), Norway (SGS), and the Wallops Orbital Tracking Station (WOTS). 263030 CH01

3.1.3.2 Data Distribution

3.1.3.2.1 EBnet shall provide connectivity and data transport between the ground EOSDIS elements based on EOS traffic flows contained in the EBnet Traffic Database [10]. 263040

3.1.3.2.2 The EBnet Traffic Database shall include traffic flows in and out of ECS. 263050 CH02

3.1.3.2.3 The EBnet Traffic Database shall include traffic flows for real-time telemetry, command, and control as addressed in Table 4 of the ESDIS Project Level 2 Requirements Volume 0, Overall ESDIS Project Requirements. 263060

3.1.3.2.4 EBnet shall have a contribution to the overall real-time operations (command up to acknowledge back) loop delay of no more than 0.75 seconds. 263070

3.1.3.2.5 Ebnet shall transfer science data at a minimum of 31 Mb/sec from the ground station to the EDOS element at GSFC. 263080 CH02

3.1.3.3 Communications and Networking

3.1.3.3.1 The communications and networks utilized or provided by the EBnet shall make maximum practicable use of standards for data transportation defined by the International Standards Organization's "open system interconnect." 263090

3.1.3.3.2 EBnet shall provide the capability to distribute data by electronic transmission. 263100

3.1.3.4 Network Management

3.1.3.4.1 EBnet shall provide the capability to manage EBnet system operation functions. 263110

3.1.3.4.2 EBnet shall provide the capability to manage EBnet security functions. 263120

3.1.3.4.3 EBnet shall provide end-to-end performance monitoring and control. 263130

3.1.3.4.4 EBnet shall establish and maintain accounting information on communications and networks used or provided by the EBnet. 263140

3.1.3.4.5 EBnet shall establish and maintain configuration information on communications and networks used or provided by the EBnet. 263150

3.1.3.4.6 EBnet shall provide the capability to manage EBnet fault isolation functions. 263160

3.1.3.4.7 EBnet shall have the capability to duplicate network management functionality from the sustaining engineering capability within 24 hours of the catastrophic loss of the network management system. 263170

3.1.3.4.8 EBnet shall have a management interface to ECS to exchange network management information. 263180

3.1.4 Interfaces

3.1.4.1 EBnet shall interface with the ECS (DAACs, [EOS Operations Center] EOC, System Management Center (SMC), and Affiliated Data Centers [ADCs]). 264000

3.1.4.2	EBnet/NASA Communications (Nascom) shall interface with the Flight Dynamics Facility (FDF).	264010	
3.1.4.3	EBnet/Nascom shall interface with the Network Control Center (NCC).	264020	
3.1.4.4.	EBnet/Nascom shall provide the interface with the Alaska (AGS), Norway (SGS), and with the Wallops for contingency mode operations.	264030	CH01
3.1.4.5	EBnet/Nascom shall interface with spacecraft integration and test facilities to support prelaunch activities, including spacecraft integration.	264040	
3.1.4.6	EBnet shall interface with the launch processing site to support prelaunch activities.	264050	
3.1.4.7	EBnet shall interface with the National Oceanic and Atmospheric Administration (NOAA) Facility in Suitland, Maryland.	264060	
3.1.4.8	EBnet shall interface with International Partners.	264070	
3.1.4.9	EBnet shall interface with EDOS.	264080	
3.1.4.10	EBnet shall interface with the EOSDIS Test System (ETS).	264090	
3.1.4.11	EBnet shall interface with the TRMM Science Data and Information System (TSDIS).	264100	
3.1.4.12	EBnet shall provide the interface equipment between the Landsat 7 Processing System (LPS) and the ECS, and provide switchable backup.	264110	
3.1.4.13	EBnet shall have the capability to interface with common carrier Digital Signal (DS) 1 services.	264120	
3.1.4.14	EBnet shall have the capability to interface with common carrier DS3 services.	264130	
3.1.4.15	EBnet shall have the capability to be expanded to support an interface with common carrier Optical Carrier rate of 155.520 Megabits per second (OC3) services.	264140	
3.1.4.16	EBnet shall interface to the ECS Development Facility (EDF).	264160	CH02

Abbreviations and Acronyms

ACRIM	Activity Cavity Radiometer Irradiance Monitor	
ADC	Affiliated Data Center	
ADEOS	Advanced Earth Observating Satellite	
ADS	Archive Data Sets	
AGS	Alaska Ground Station	CH01
ALT	Altimetry	
AM	EOS Morning Flight	
BER	Bit Error Rate	
C2	Level of Security Sensitivity	
CHEM	Chemistry	
COLOR	Ocean Color Flight - Sea-viewing Wide Field-of-View Sensor	
COTS	Commercial Off-The-Shelf	
CSMS	Communications and Systems Management Segment	CH02
DAAC	Distributed Active Archive Center	
DCN	Document Change Notice	
DOD	Department of Defense	
DS	Digital Signal	
		CH01
EBnet	EOSDIS Backbone Network	
Ecom	EOS Communications	
ECS	EOSDIS Core System	
EDF	ECS Data Facility	CH02
EDOS	EOS Data and Operations System	
EGS	EOS Ground System	
EOC	EOS Operations Center	
EOIS	Earth Observation Information System	CH02
EOS	Earth Observing System	

EOSDIS	EOS Data and Information System	
ESDIS	Earth Science Data Information System	
ESN	EOSDIS Science Network	
ETS	EOSDIS Test System	
FDF	Flight Dynamics Facility	
FOS	Flight Operations Segment (ECS)	CH02
		CH01
GDS	Ground Data System	CH02
GSFC	Goddard Space Flight Center	
IP	Internet Protocol	
IST	Instrument Support Toolkit	CH02
LAN	Local Area Network	
LPS	LANDSAT Processing System	
MTPE	Mission To Planet Earth	
MTTRS	Mean Time To Restore Service	
NASA	National Aeronautics and Space Administration	
Nascom	NASA Communications	
NCC	Network Control Center	
NHB	NASA Handbook	
NMI	NASA Management Instruction	
NOAA	National Oceanic and Atmospheric Administration	
NSI	NASA Science Internet	
NSIDC	National Snow and Ice Data Center (DAAC)	CH02
OC3	Optical Carrier rate of 155.520 Megabits per second	
ODC	Other Data Center	CH02
PDS	Production Data Sets	
PM	EOS Afternoon Flight	
QDS	Quick-Look Data Sets	
		CH02

RMA	Reliability, Maintainability, and Availability	
SAA	Satellite Active Archive (NOAA)	CH02
SAGE	Stratospheric Aerosol and Gas Experiment	
SCF	Science Computing Facility	
SDPF	Science Data Procesing Facility	
	Sensor Data Processing Facility (GSFC)	
SEDAC	Socio-Economic Data and Applications Center (CIESIN)	CH02
SGS	Svalbard Ground Station	CH01
SMC	System Management Center	
SOLSTICE	Solar Stellar Irradiance Comparison Experiment	
TBR	To Be Reviewed	
TRMM	Tropical Rainfall Measuring Mission	
TDRS	Tracking and Data Relay Satellite	CH02
TDRSS	Tracking and Data Relay Satellite System	
TSDIS	TRMM Science Data and Information System	
WAN	Wide Area Network	
WOTS	Wallops Orbital Tracking Station	

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Glossary

A_o	see operational availability.
common carrier	the common carrier side of the transport equipment. interface
contingency mode	command and spacecraft telemetry operations in the event of a nonavailability of Tracking and Data Relay Satellite System (TDRSS) capability.
corrective maintenance	all actions performed as a result of failure to restore an item to a specified condition. Corrective maintenance can include any or all of the following steps: localization, isolation, disassembly, interchange, reassembly, alignment, and checkout.
data driven	a system that uses routing identification information resident in the communications data structures to provide all necessary information in order to establish end-to-end communications.
element	hardware or software that can be identified as an individual item, assembly, combination of subassemblies, or software modules that have specific function.
MTTRS	Mean Time To Restore Service—the total corrective maintenance time associated with downing events, divided by the total number of downing events during a stated period of time. Excludes time for off-system maintenance and repair of detached components. The MTTRS must be maintained for each EBnet user service (i.e., it is not the average across all user services).
operational availability	A_o—the time service is available is measured over a contiguous 10,000-hour interval except that any loss of availability due to loss of facility services, such as power or air conditioning, shall not be counted. The time service is not available shall include all times service is not available due to corrective maintenance downtime, administrative downtime, logistics supply downtime, and preventive maintenance downtime. It is determined as follows: A_o = mean time service is available / (mean time service is available + mean time service is not available)
preventive maintenance	all actions performed in an attempt to retain an item in specified condition by providing systematic inspection, detection, and prevention of incipient failures.
real-time data	includes spacecraft commands, housekeeping data, housekeeping playback data, tracking data, and science telemetry.

science data	science data includes quick-look data sets (QDSs), production data sets (PDSs), and archive data sets (ADSs) transferred from the EDOS to the DAACs and between DAACs.
user	any organizational entity that uses Ebnet.

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